

# MEASUREMENTS AND CONVERSIONS

The following information is provided to assist the reader in understanding certain concepts in this *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico* (CT EIS). Definitions of technical terms can be found in Chapter 22, Glossary.

## Scientific Notation

Scientific notation is used in this report to express very large or very small numbers. For example, the number 1 billion could be written as 1,000,000,000 or, using scientific notation, as  $1 \times 10^9$ . Translating from scientific notation to a more traditional number requires moving the decimal point either right (for a positive power of 10) or left (for a negative power of 10). If the value given is  $2.0 \times 10^3$ , move the decimal point three places (insert zeros if no numbers are given) to the right of its current location. The result would be 2,000. If the value given is  $2.0 \times 10^{-5}$ , move the decimal point five places to the left of its present location. The result would be 0.00002. An alternative way of expressing numbers, used primarily in the appendices of this CT EIS, is exponential notation, which is very similar in use to scientific notation. For example, using the scientific notation for  $1 \times 10^9$ , in exponential notation the  $10^9$  (10 to the power of 9) would be replaced by E+09. (For positive powers, sometimes the “+” sign is omitted, and so the example here could be expressed as E09.) If the value is given as  $2.0 \times 10^{-5}$  in scientific notation, then the equivalent exponential notation is 2.0E-05.

## Units of Measurement

The primary units of measurement used in this report are English units with metric equivalents enclosed in parentheses.

Many metric measurements presented include prefixes that denote a multiplication factor that is applied to the base standard (e.g., 1 kilometer = 1,000 meters). The following list presents these metric prefixes:

giga	1,000,000,000 ( $10^9$ ; E+09; one billion)
mega	1,000,000 ( $10^6$ ; E+06; one million)
kilo	1,000 ( $10^3$ ; E+03; one thousand)
hecto	100 ( $10^2$ ; E+02; one hundred)
deka	10 ( $10^1$ ; E+01; ten)
unit	1 ( $10^0$ ; E+00; one)
deci	0.1 ( $10^{-1}$ ; E-01; one tenth)
centi	0.01 ( $10^{-2}$ ; E-02; one hundredth)
milli	0.001 ( $10^{-3}$ ; E-03; one thousandth)
micro	0.000001 ( $10^{-6}$ ; E-06; one millionth)
nano	0.000000001 ( $10^{-9}$ ; E-09; one billionth)
pico	0.000000000001 ( $10^{-12}$ ; E-12; one trillionth)

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U.S. Department of Energy (DOE) Order 5900.2A, Use of the Metric System of Measurement, prescribes the use of this system in DOE documents. Table MC-1 lists the mathematical values or formulas needed for conversion between English and metric units. Table MC-2 summarizes and defines the terms for units of measure and corresponding symbols found throughout this report.

### Radioactivity Unit

Part of this report deals with levels of radioactivity that might be found in various environmental media. Radioactivity is a property; the amount of a radioactive material is usually expressed as “activity” in curies (Ci) (Table MC-3). The curie is the basic unit used to describe the amount of substance present, and concentrations are generally expressed in terms of curies per unit of mass or volume. One curie is equivalent to 37 billion disintegrations per second or is a quantity of any radionuclide that decays at the rate of 37 billion disintegrations per second. Disintegrations generally include emissions of alpha or beta particles, gamma radiation, or combinations of these.

### Radiation Dose Units

The amount of ionizing radiation energy received by a living organism is expressed in terms of radiation dose. Radiation dose in this report is usually expressed in terms of effective dose equivalent and reported numerically in units of rem. Rem is a term that relates ionizing radiation and biological effect or risk. A dose of 1 millirem (0.001 rem) has a biological effect similar to the dose received from about a 1-day exposure to natural background radiation. A list of the radionuclides discussed in this document and their half-lives is included in Table MC-4.

### Chemical Elements

A list of selected chemical elements, chemical constituents, and their nomenclature is presented in Table MC-5.

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Table MC-1. Conversion Table

MULTIPLY	BY	TO OBTAIN	MULTIPLY	BY	TO OBTAIN
ac	0.405	ha	ha	2.47	ac
°F	$(^{\circ}\text{F} - 32) \times 5/9$	°C	°C	$(^{\circ}\text{C} \times 9/5) + 32$	°F
ft	0.305	m	m	3.28	ft
ft <sup>2</sup>	0.0929	m <sup>2</sup>	m <sup>2</sup>	10.76	ft <sup>2</sup>
ft <sup>3</sup>	0.0283	m <sup>3</sup>	m <sup>3</sup>	35.3	ft <sup>3</sup>
ft <sup>3</sup>	28.32	l	l	0.0353	ft <sup>3</sup>
gal.	3.785	l	l	0.264	gal.
in.	2.54	cm	cm	0.394	in.
lb	0.454	kg	kg	2.205	lb
mCi/km <sup>2</sup>	1.0	nCi/m <sup>2</sup>	nCi/m <sup>2</sup>	1.0	mCi/km <sup>2</sup>
mi	1.61	km	km	0.621	mi
mi <sup>2</sup>	2.59	km <sup>2</sup>	km <sup>2</sup>	0.386	mi <sup>2</sup>
nCi	0.001	pCi	pCi	1,000	nCi
oz	28.35	g	g	0.0353	oz
pCi/l	10 <sup>-9</sup>	μCi/ml	μCi/ml	10 <sup>9</sup>	pCi/l
pCi/m <sup>3</sup>	10 <sup>-12</sup>	Ci/m <sup>3</sup>	Ci/m <sup>3</sup>	10 <sup>12</sup>	pCi/m <sup>3</sup>
pCi/m <sup>3</sup>	10 <sup>-15</sup>	mCi/cm <sup>3</sup>	mCi/cm <sup>3</sup>	10 <sup>15</sup>	pCi/m <sup>3</sup>
ppb	0.001	ppm	ppm	1,000	ppb
ton	0.907	metric ton	metric ton	1.102	ton
yd <sup>3</sup>	0.7641	m <sup>3</sup>	m <sup>3</sup>	1.308	yd <sup>3</sup>

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**Table MC-2. Names and Symbols for Units of Measure**

LENGTH	
Symbol	Name
cm	centimeter ( $1 \times 10^{-2}$ m)
ft	foot
in.	inch
km	kilometer ( $1 \times 10^3$ m)
m	meter
mi	mile
mm	millimeter ( $1 \times 10^{-3}$ m)
$\mu\text{m}$	micrometer ( $1 \times 10^{-6}$ m)
VOLUME	
Symbol	Name
$\text{cm}^3$	cubic centimeter
$\text{ft}^3$	cubic foot
gal.	gallon
$\text{in.}^3$	cubic inch
l	liter
$\text{m}^3$	cubic meter
ml	milliliter ( $1 \times 10^{-3}$ l)
ppb	parts per billion
ppm	parts per million
$\text{yd}^3$	cubic yard
RATE	
Symbol	Name
Ci/yr	curies per year
$\text{cm}^3/\text{s}$	cubic meters per second
$\text{ft}^3/\text{s}$	cubic feet per second
$\text{ft}^3/\text{min}$	cubic feet per minute
gpm	gallons per minute
kg/yr	kilograms per year
km/h	kilometers per hour

**Table MC-2. Names and Symbols for Units of Measure (Continued)**

RATE	
Symbol	Name
mg/l	milligrams per liter
mg/y	million gallons per year
mly	million liters per year
$\text{m}^3/\text{yr}$	cubic meters per year
mi/h or mph	miles per hour
$\mu\text{Ci/l}$	microcuries per liter
$\text{pCi/l}$	picocuries per liter
tpy	tons per year
mt/y	metric tons per year
NUMERICAL RELATIONSHIPS	
Symbol	Meaning
<	less than
$\leq$	less than or equal to
>	greater than
$\geq$	greater than or equal to
$2\sigma$	two standard deviations
TIME	
Symbol	Name
d	day
h	hour
min	minute
nsec	nanosecond
s	second
yr	year
ELECTRICITY	
Symbol	Name
gwh	gigawatt-hour
mw	megawatt

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**Table MC-2. Names and Symbols for Units of Measure (Continued)**

AREA	
Symbol	Name
ac	acre (640 per mi <sup>2</sup> )
cm <sup>2</sup>	square centimeter
ft <sup>2</sup>	square foot
ha	hectare (1 x 10 <sup>4</sup> m <sup>2</sup> )
in. <sup>2</sup>	square inch
km <sup>2</sup>	square kilometer
mi <sup>2</sup>	square mile
MASS	
Symbol	Name
g	gram
kg	kilogram (1 x 10 <sup>3</sup> g)
mg	milligram (1 x 10 <sup>-3</sup> g)
μg	microgram (1 x 10 <sup>-6</sup> g)
ng	nanogram (1 x 10 <sup>-9</sup> g)
lb	pound
ton	metric ton (1 x 10 <sup>6</sup> g)
oz	ounce
TEMPERATURE	
Symbol	Name
°C	degrees Celsius
°F	degrees Fahrenheit
°K	degrees Kelvin
SOUND/NOISE	
Symbol	Name
dB	decibel
dBA	A-weighted decibel

**Table MC-3. Names and Symbols for Units of Radioactivity**

RADIOACTIVITY	
Symbol	Name
Ci	curie
cpm	counts per minute
mCi	millicurie (1 x 10 <sup>-3</sup> Ci)
μCi	microcurie (1 x 10 <sup>-6</sup> Ci)
nCi	nanocurie (1 x 10 <sup>-9</sup> Ci)
pCi	picocurie (1 x 10 <sup>-12</sup> Ci)

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**Table MC-4. Radionuclide Nomenclature**

SYMBOL	RADIONUCLIDE	HALF-LIFE	SYMBOL	RADIONUCLIDE	HALF-LIFE
Am-241	americium-241	432 yr	Pu-241	plutonium-241	14.4 yr
H-3	tritium	12.26 yr	Pu-242	plutonium-242	$3.8 \times 10^5$ yr
Mo-99	molybdenum-99	66 hr	Pu-244	plutonium-244	$8.2 \times 10^7$ yr
Pa-234	protactinium-234	6.7 hr	Th-231	thorium-231	25.5 hr
Pa-234m	protactinium-234m	1.17 min	Th-234	thorium-234	24.1 d
Pu-236	plutonium-236	2.9 yr	U-234	uranium-234	$2.4 \times 10^5$ yr
Pu-238	plutonium-238	87.7 yr	U-235	uranium-234	$7 \times 10^8$ yr
Pu-239	plutonium-239	$2.4 \times 10^4$ yr	U-238	uranium-238	$4.5 \times 10^9$ yr
Pu-240	plutonium-240	$6.5 \times 10^3$ yr			

**Table MC-5. Elemental and Chemical Constituent Nomenclature**

SYMBOL	CONSTITUENT	SYMBOL	CONSTITUENT
Ag	silver	Pa	protactinium
Al	aluminum	Pb	lead
Ar	argon	Pu	plutonium
B	boron	SF <sub>6</sub>	sulfur hexafluoride
Be	beryllium	Si	silicon
CO	carbon monoxide	SO <sub>2</sub>	sulfur dioxide
CO <sub>2</sub>	carbon dioxide	Ta	tantalum
Cu	copper	Th	thorium
F	fluorine	Ti	titanium
Fe	iron	U	uranium
Kr	krypton	V	vanadium
N	nitrogen	W	tungsten
Ni	nickel	Xe	xenon
NO <sub>2</sub> -	nitrite ion	Zn	zinc
NO <sub>3</sub> -	nitrate ion		